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The relationship performance in the field of university–industrial R&D cooperation

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To provide the long term success of the relationships between innovative institutions – like universities, firms and bridging institutions – it is of key importance that regional developments be focused on the dynamisation of knowledge centres and increasing competitiveness. One of the elementary pillars is the long term co-operation between innovative institutions. In this case, focus is placed upon the success of co-operation and two questions are asked: How can the projects within the co-operation be successfully managed and how can a co-operation containing different ranges of projects be managed? Research conclusions are still ongoing with the latter question. The economic results and benefits from the university-industrial R&D co-operation are clearly explored and presented. Therefore, the approaches which describe the performance of the university-industrial co-operations, highlighted by the discrepancy of the different approaches are analysed. On the basis of qualitative research, a motion is made of the adaptability of the discrepancy resolving performance model.

Keywords: university-industrial co-operations, relationship performance

1. Introduction

The capacity and manageability of relations between universities and industries has special significance in the age of heightened support for such co-operative research and development (R&D). Relationship performance – as the economic advantage of co-operation between organisations – appears as a concept enjoying rather large interest in the concerning literature. Relationship performance appeared as the "by-product" of relationship marketing and management analyses in the 1990s, while at the time of the millennium, results of analyses targeting factors impacting the capacity of relationships started sprouting everywhere.

The objective of this paper is to present the specialities, along which performance relationship can be characterised in the field of vertical university-industrial R&D co-operation[3], and what factors can describe it; in other words, what

[3] For the purposes of this study, hereinafter, vertical R&D co-operation realised in relation of university and industrial actors will be regarded as all series of interaction including a line of development projects regulated by contract and realised between a university unit and corporate partner where central results and the private goods and the relation and position of various projects are clarified in the research co-ordination of the university.

advantages derive in the field from maintaining the relationship itself? The article explores the aforementioned problem along three main thought-lines. The initial part features the main approaches to the profitability and effectiveness of vertical university-industrial co-operation both from universities and industries perspectives, pointing out the problems of the approaches that have been identified. In the second part, the results of the qualitative analysis initiated to resolve those problems have been described. While in the final part, relying partly on analytical results, a model is presented that is capable of describing the performance of vertical university-industrial co-operation.

2. Interpreting relationship performance during university-industrial vertical R&D co-operation

Focusing on the performance of R&D co-operation during examination, a field that is difficult to manage is identified. In R&D co-operation (primarily in the case of vertical co-operation), the concept and relation of service provider and user is valid and observable. However, if that which is in a non business-business relationship system is interpreted, significantly different interests and expectations can be identified, which make the evaluation of the performance of the co-operation complicated.

University and academic research traditionally targets the creation and deepening of basic knowledge and its integration into the general educational order. The academic sphere focuses primarily on new scientific fields not yet covered, which are useful in providing a long-term aspect in the topics of basic and applied research and which serve as a basis for training future scientists, experts and researchers (Santoro 2000). Requirements towards co-operation on the public side can be summarized as revenue production, widening the political base, maximizing prestige, research-educational overflow, increasing reference and reputation, acquiring human resource capacity, increasing its exploitation, acquiring tools, etc… (Slaughter–Leslie 1999). In contrast, business partners are interested in selling research results and the applied solution of problems, which are capable of maximizing profitability and the wealth of stakeholders, reducing risks, increasing market share, revenues or the economies of scale (Hagedoorn et al 2000, Santoro 2000, Barnes et al 2002, Tijssen 2001, Okamuro 2007, Harabi 2002).

Omta and de Leeuw (1997) attempted to resolve the problem by starting out from a buyer-oriented approach during the definition period of the co-operation performance of the two parties. According to the authors, performance – in this context – is the most efficient combination of resources used by all participants of the suppliers' network so that it leads to high quality and a cost-efficient buyer-service. This means that the organizations must ensure that they provide good services to their buyers in the given time and in good quality. On the other hand, it

also means that they must be able to increase efficiency (good things are to be done well). Therefore, returning back to the traditional approach to performance, the latter compares the output with the invested input and with the visible use of the output gained by the buyer. While the input invested in co-operation is easy to describe as the output of R&D co-operation, there is a fundamental differentiation between output focused on an academic community (research performance) and output focused on industrial and governmental users (users' performance). Regarding output focused on industrial partners, the intellectual value (patent, licence, etc.) that was created as a result of the co-operation (innovative performance) and the process-performance provided during the co-operation as efficiency, which includes maintaining the preliminarily stipulated cost and time frame (industrial performance) are evaluated as performance.

At the same time, performance management experience shows that performance cannot be regarded as a homogenous concept, that would be an exaggerated (although during research, in many cases, practical) simplification to limit it to the results. Barnes et al (2002), while examining the relationship system of Warwick University and the Warwick Manufacturing Group with qualitative tools, emphasizes that results (which the authors define as owners' profit, technological innovation, continuous support of research programs, submission of publications and patents, the realization of students' projects and the strengthening of students' recruitment), project management, ensuring equality and monitoring (which are enforceable through the management of objectives and resources, communication, balanced power relations and stability), and general success factors (which include factors like learning, or good personal relationships) can be accounted for as central factors of the success of co-operation. This logic suggests that the result-processes-abilities approach applicable to the description of the performance of supplier-buyer relationships is also valid in an R&D environment, which is underlined by Daniel et al (2002), which, as a result of a quantitative examination of 58 American co-operation research centres, describes co-operation performance with that logic. In this latter model, result is modelled with satisfaction and commitment, while processes with technology transfer behaviour. Abilities are defined as research capacities.

If, therefore, the applicability of the result-process-ability approach is accepted, it is worth reviewing what factors influence it based upon research done so far, and which factors constitute an integral part of the performance of vertical R&D co-operation.

Branstetter and Sakakibara (1998) provides a pronounced proposal for the result-side evaluation of the performance of R&D co-operation, stating that research productivity can be defined as co-operative R&D performance, manifesting in the number of patents created from it. This performance can primarily be defined as the technological performance of R&D co-operation, which although, the argument goes, only presents part of the acquired economic profit, at the same time, the

various co-operations and branches of industry become comparable due to the construction (Branstetter–Sakakibara 2002). Revilla et al (2000), however, present arguments in favour of the technical and economic dimensions having to be evaluated during the evaluation of the results of co-operative R&D. The authors' performance definition relies on simple and well applicable logic: (1) performance is relative; its size significantly depends on starting conditions, against whom the relative size and adequacy of output can be measured; (2) both technological and economic performance must be considered during its evaluation. They apply three input and three output variables to describe performance in their analytical model. As input variables, they define the total revenues of the company, the number of employees (at the company) and the total R&D budget, while output variables include the number of patents deriving from co-operation, the number of those employed due to co-operation and total revenues generated by co-operation. Miotti and Sachwald (2003) got a similar result, also describing the efficiency of R&D co-operation with two variables, patent productivity and the proportion of innovative products within total revenues. During defining, the authors start out from the fact that the productivity of R&D activities can be described along two factors: first, technological productivity (that is, whether during R&D any result has been achieved that constitutes a technological novelty) and second, the success of market enforcement, which, separated from the former is evaluated more as the success of production and/or marketing. The same definitional result forms the starting point of Okamuro (2007) with a supplement, according to which technological success is grasped as a patentable or a subjectively valuable result (and not merely evaluating the established patents, but shifts towards a value-based approach). The author also extends business success and defines it to the extent of which co-operative R&D contributes to the increase of sales.

Among the approaches pointing beyond the evaluation of results, Brinkerhoff (2002) is to be highlighted. According to which, performance cannot be narrowed down to financial performance, but the processes that bring it about must also come in focus. The author also states that performance cannot be approached exclusively from the side of the achieved results in the case of public institutions either. In his analogy, he shows that although price/value ratio of the created products and services is also an important aspect in the case of the private sector, investors are, at the same time, interested in the effectiveness and efficiency of their creation as well. Song et al (1997) also provides an examination along the lines of that approach, as pertaining to the effects of internal and external factors and inter-functional communication on the development performance of a new product in the case of cross-functional co-operation. The analysis from our aspect is important regarding grasping performance which is described with product quality, product development speed, conjunction of product development objectives and the success of the program. According to the authors' aspect, the real value of cross-functional co-operation is the potential that can increase the performance of the company on the

market, which can be displayed in many indices (product quality evaluation; development of cycle time; cost decrease; profit from projects, sales or market share). According to the authors, cross-functional co-operation primarily supports the conclusion of development projects in time, within the budget and in accordance with preliminary plans. Therefore, quality and the time factor are to be highlighted, since they result in a tangible competitive advantage, while other economic factors are described by the success of the program and the fulfilment of the objectives. Harabi (2002) also analyses a model managing both results and processes where during the analysis, the efficiency of R&D co-operation is modelled with 6 fundamental variables: patent protection, planning schedule, discretion, the complexity of product design, the running time of products and the long-term employment of qualified staff. In contrast, the author deals with the success of R&D co-operation separately, as described by achieving objectives. He deals with the following objectives as variables from the aspect of vertical R&D co-operation: first, objectives concerning cost decrease, second, objectives serving expansion on global markets, and third, objectives serving the creation of new local markets. During his analysis, however, Harabi touches upon a further intriguing question: how can it be evaluated what values the source of innovation carries in the case of co-operation among two parties? This question leads to the interpretation of co-operational abilities.

The joint interpretation of results, processes and abilities (Barnes et al 2002, Daniel et al 2002) has already been mentioned. Besides the aforementioned, it also must be taken into account the approach of Belderbos et al (2004), according to which the performance of co-operative R&D can be grasped in: risk and cost sharing, shortening the development cycle, exploiting economic advantages, like economies of scale, synergic effects or a more efficient utilisation of the resources of participants, learning realized through monitoring technologies, market development, and an increased access to governmental subsidies.

As a result of the literary survey, it may be summarized that the performance of R&D co-operation at the level of results can be defined as technical and economic performance. It can be defined at the level of processes as the shortening of development time, the success of planning and realization, the success of communication and as a fulfilment of other specific processes. While in the aspect of abilities, learning, personal relationships and research capacities can be defined.

At the same time, the analyses of public-private R&D co-operation show a very controversial image. Omta and de Leeuw (1997), for instance, state that the control of the processes of co-operation between research institutions and businesses has no significant impact on results, while Daniel et al (2002) concludes that processes (in their model, communicational behaviour) have a decisive impact on satisfaction. On the other hand, Miotti and Sachwald (2003) found empirical evidence that in the case of co-operation with public-type institutions technological performance was high (beside a lower level of economic performance), and the

quantitative analysis of Okamuro (2007) leads the author to conclude that co-operation with universities has a negative impact on economic performance, while no significant impact on technological performance. Belderbos et al (2004), at the same time, finds that university-industrial co-operation has a positive impact on the productivity of innovative sales (economic performance). Upon interpreting the various approaches, two problems emerge during the evaluation of the performance of R&D co-operation. First, during the evaluation of the performance of R&D co-operation the performance of projects and the performance of co-operation are not separated. That is a problem because, if the two concepts were separated, it would become clear that the performance of co-operation has an impact on the performance of projects. Also, the lack of interpreting network relationships can also be identified as a problem. The various interpretations attempt to define the performance of co-operation separately (focusing on dyads), while at the same time, especially in the case of scientific and technological co-operation, network relationships can be decisive. In that aspect, Tijssen (1998) is very clear in stating that public-private R&D relationships manifest in an industrial contractual research in a network implemented by the research institutions. The inputs, interim results and outputs of such a network are extremely diverse. They depend on human resources, codified scientific knowledge and the connected hidden knowledge to manifest technological results like patents, technological designs, tools, parts, and prototypes. Such technological networks play a key role in inter-sectorial communication and in the interaction of knowledge-intensive fields and industrial branches.

In order to resolve these two problems, within a qualitative analysis, the model of the performance of vertical university-industrial co-operation has been prepared.

3. The performance of vertical R&D co-operation: findings of the qualitative analysis

3.1. The background of the analysis

The topic of the qualitative, interview examination was the specialties alongside which relationship performance could be described in the field of R&D co-operation and the factors it could be described with. In other words, what advantages derived in this field from the maintenance of the relationship itself? The research objective was designated so as to define the possible factors of the concept, from a perspective considering both the service provider, as the supplier, and the user of the service, as buyer, based upon the result–process–ability approach identifiable from the literary analysis of relationship performance. The research methodology approach is qualitative and exploratory. In order to establish the model, in-depth interviews were made with both service providers and users in the field of their R&D co-operation in

a total of 20 cases. The subjects were corporate and/or research institute contact persons of a given co-operation and experts assuming a bridge building role in the field (R&D consultants and technology transfer experts). When selecting contact person subjects, it was a condition that the subject had fulfilled the role of contact person or project manager of at least one co-operation that contained at least two already concluded projects. While in the case of expert subjects, it was a condition that the subject had participated in the development of at least three co-operations in the past three years that contained at least two concluded projects. The analysis witnessed eight corporate, eight university and four expert queries concerning Szeged and its surroundings and Düsseldorf and its surroundings. Topics of the expert interviews were the following:

a/ interpreting the meaning of relationship performance
b/ financially decisive and financially less interpretable factors of relationship performance
c/ impact on relationship performance by third parties (the network aspect of relationship performance)

The interpretation and factors of performance were explored along four aspects during interviews:

1. Profitability of relationship-building and its conditions (see Medlin 2003, Medlin et al 2005, Leuthesser–Kohli 1995).
2. Changes in the expenditure and advantages of developing and maintaining co-operation during the course of time (see Storbacka 1997, Heide–Stump 1995, Kalwani–Narayandas 1995).
3. Analysing the advantages and expenditure of co-operation in a way that the service provided/used within the co-operation was compared with a similar service provided/used without any partnership (see Joseph et al 1995, Brinkerhoff 2002).
4. Analysing the advantages and expenditure of co-operation through comparison of a productive and successful and a productive but problematic co-operation.

3.2. Key responder results

3.2.1. Profitability of relationship–building and its conditions

Research institute responders regarded establishing and maintaining a co-operation profitable if it resulted in continuous and predictable revenues, decreased alternative partner-seeking costs (emerging separately in the case of individual projects), provided foreseeable capacity utilisation (labour force and labs) and also offered (publishable) scientific results beyond fulfilling the project. The co-operation could also be found profitable if there were financially tangible advantages like revenues, the predictability of capacity utilisation, and decreasing purchasing costs. Exceeding the expenditures of developing in maintaining the co-operation were things such as

labour costs, travel and accommodation costs, conference costs, representational costs, communicational costs, and the costs of submitting applications. Advantages of co-operation mentioned that are not directly in financial terms are flexibility emerging between the partners, providing services adapting to the demands of the partner, the development of a partner-oriented approach, project generating in many fields, multi-field support of each others' activities, the creation of patents and preparing publications and references.

"Two fundamental productivity requirements must be highlighted in the case of every co-operation…first, the co-operation must contain projects that generate revenues…second, a scientific 'delicacy', a novelty must emerge from the co-operation, because there is no capacity for scientific content to be separated from industrial projects… The co-operation is worth developing, if the combination of the results created in the two fields is more valuable than the expenditure of the development and maintenance of the relationship." (One of the university respondents.)

The corporate side saw the condition of the profitability of co-operation primarily in increasing or the possibility to increase the tightness of the relationship. According to corporate co-operators, the performance of a good relationship appears in the fact that project objectives are defined jointly and, as a result, answers to emerging problems can be found at a lower expenditure rate. The co-operation is profitable if the financially tangible advantages like lawyers', communicational, travel, telephone and representational costs, personnel expenditure invested in the development of the relationship, the costs of the development and maintenance of control mechanisms and reputational costs emerging within the company during proving the necessity of co-operation are lower than what the revenues deriving from the co-operation, the shortening of development time, savings on recruitment costs and, possible, sales of other products of the company constitute. As part of the financially intangible advantages of co-operation, companies mentioned the deeper familiarisation with each other's demands and competences, joint individual and group level learning, the development of individual relationship capital and expert relationship net, and, due to R&D relationships, the development and expansion of the acknowledgement of the company.

"Basically the advantages deriving from getting to know each other's demands and competences can be highlighted from the relationship system. The common learning process and satisfaction deriving from useful products and services are important."(Respondent from one of the companies)

According to experts, the development of co-operation primarily means expenditure where partners are motivated either by communication (work time) or financial motivation. Returns for all that are to be covered by other projects initiated in the co-operation. Expert interviews emphasised informal advantages as *"…providing a position for each other, …providing information, providing access to own acknowledgement, providing vouchers for other rights, …access to other*

resources" as non-financial advantages of co-operation, highlighting the role of references and recommendations.

3.2.2. Changes in the expenditure and advantages of developing and maintaining co-operation during the course of time

During the examination of the changes in returns and expenditure of co-operation in time, research institute responders underlined that an inverse relation could be observed during the course of the appearance of expenditure and revenues. *"The life-curve is interpretable here too …initially, interaction is very frequent, then –* with the increase of confidence and the knowledge of each other's demands *– it decreases"*. Accounted advantages appear in later phases. In the case of financially less-tangible advantages, research institute actors experienced continuous growth during the development of the co-operation. They emphasised the increase of flexibility, the improvement of planning punctuality, the emergence of other fields of development growing out of the co-operation, a partner-oriented development of the academic way of thinking, and the realisation of common learning.

"A central budget research location is rather rigid, and it is invaded by a completely different logic, or approach. The result of that is that the rigid, academic way of thinking gradually eases …Learning also appears as a significant profit. It is obviously mutual, but I can only comment on what I have learnt: for instance, how to create a good application, and also various economic skills, how the partner company operates, what magnitude and type of efforts are required in its maintenance, what their processes are like, what is important to them…"(One of the university respondents)

According to corporate findings, following the phase of the establishment of the co-operation, personnel expenditure demanded by a single project decreases, while the number of projects increases. Corporate participants highlighted the increase in the acknowledgement and reputation of the company and the realisation of common learning among financially intangible factors during the development of the co-operation.

"The increase of advantages can be explained by the increase in the number of projects. Acknowledgement within the company has significantly grown …however, to what extent university co-operation contributed to that, is an exciting question." (One of the company respondents)

According to expert responders, the advantage of co-operation can be grasped in the decrease of formality with the assertion of the dimension of time. They believe that the decrease of formality results in the decrease of transaction costs. Simultaneously, willingness of payment by the user increases and the buyer uncertainty decreases towards the received service, so there is disposition to pay a higher price. Nonetheless, expert interviews also pointed out that this cannot be evaluated as a linear process, since the position of the partners is modified by external or internal environmental changes, which can trigger crises in the co-

operation and once again point towards formalisation and the increase of transaction costs. Responding experts highlighted the development of control and the shortening of informational paths among financially intangible factors during the development of the co-operation. They believe that the underlying reason for this is that if "*…co-operation works well, the star-shape* – initially optimised to persons – *turns into a network format …"*, and the understanding of each other's demands and opportunities quickens, communication improves; outputs appear sooner, deadlines are more easily kept and it becomes possible to integrate into the partner organisation better and more easily.

3.2.3. Analysing the advantages and expenditure of co-operation and service providing without co-operation

Research institute responders seldom identified new factors in the case of this item, with the exception of one. They did, however, underline the already mentioned expert opinion that states the decrease of the sense of risk of the user results in higher project revenues and is an important advantage of co-operation. Beyond the aforementioned, better predictability, scientific and publication proceeds and a higher flexibility of the project management appeared as important advantages of co-operation. *"It is not worth it without co-operation. There are no publication proceeds; while the cost and time spent on a routine examination is high …It is difficult to enforce the loss of time in the price."* The possibility of accessing new markets and new customers appeared as a new factor among the advantages of co-operation.

It was primarily corporate responders who unveiled new factors in the case of this item. They emphasised that co-operation, contrary to its non-existence, led to routines that could decrease organising, legal and control costs. *"…routine tasks can be delegated, but they would consume high organising and legal costs; responsibility would be difficult to enforce and the cost of control would be high."* Besides that, as advantages of co-operation, they highlighted factors difficult to grasp financially, like a deeper understanding of corporate problems, getting to know each other's demands, and realising co-operation based upon confidence.

"…it is fundamentally satisfaction and a utilisable output meeting demands that easily emerges from a long-term relationship." (One of the company respondents)

Responding experts highlighted the confidence laid in R&D services, which they defined in a way that it"*…brings value into a relationship, opportunities, information, PR and results*".

3.2.4. Analysing the advantages and expenditure of co-operation through comparison of productive and successful and problematic co-operations

Responders practically summarized their previous experiences along this item, which provided an interesting contrast of the expectations of the parties towards each other that the well performing co-operation was capable of managing. The parameters of successful co-operation, through the eyes of research institute participants, were the following: it had a clear definition of problems, clear objectives, good communication, good planning, a capability of following organisational changes of participating parties, good task sharing, a clear interest on behalf of parties and basic professional consensus.

"…A real-life example could be brought up when a large organisation was the co-operating partner. As opposed to successful co-operation, the problems there were due primarily to the fact that the co-operation was unable to follow the organisational transformation of the company, and the subject of co-operation, the conditions of evaluation, etc. were constantly changing…"(One of the university respondents)

(…)

"…In other cases, it can be problematic when the co-operating party knows what it wants, perhaps thinks it knows how to achieve it, but does not dig into the depth of the solution. It therefore constantly argues, and does not behave as a partner, but as a capacity using customer in a field where it otherwise has limited experience."(One of the university respondents)

(…)

"Let us take, for example … KFT. The industrial partner expected too much, the university partner promised too much. …They did not fully clarify the objective, and their communication gradually went off track. The exciting part in all that was that after identifying the problem, the co-operation continued and the defined problem was solved." (One of the university respondents)

The same topic on the side of corporate participants was worded as follows: *"…the partner is capable of facilitating the development project, it is not necessary to intervene, the level of conflict is lower"*. The results of expert queries successfully demonstrated the third side of the issue. Responding experts laid the emphasis on the relationship system of the parties under this item where they highlighted the following elements as characteristics of successful co-operation: *"…confidence + communication + willingness to co-operate …+ risk tolerating ability"*.

3.2.5. The impact of third parties on relationship performance

During the examination of the impact of third parties on relationship performance, three issues were fundamentally analysed: first, whether an R&D co-operation depended on third parties, second, what role third parties assumed and third, how strong the dependency was on third parties. Although the answers to the questions

could easily be anticipated in light of previous examinations, their analysis was important, since, from one point of view, a clearly negative answer given to either question could challenge the validity of modelling the network effect and, alternatively, it was the distinct objective to refine the already explored factor system of the network effect in accordance with the characteristics of the relationships.

As a result of the queries, it has become clear that R&D co-operations are definitely influenced by third parties. Among the latter, responders highlighted institutional administration, the public funder, the sponsor, consultants of the partners, other partners of the research institutes or the companies, the owners of the companies, the special utiliser and the user. The image presented by research institute participants identified rather diverse roles concerning the method of influence. Internal influencers had a primary impact on the creation of the framework conditions of the co-operation. The public funder either appeared as a potential supporter or obstructer due to the timely allocation of public funds. Corporate consultants or other institutions appeared as potential rivals or obstructing factors who were interested in acquiring projects feasible in the co-operation.

"If public funds appear in the project, the dependency on the third partner is very high. If we heed to the rules, these depending relationships are not decisive, but they do have an influence. The influence can be foreseen, it is a matter of decision, whether we want to exploit it. For instance, it is dangerous to constantly change the university regulatory environment, because that always results in new decision situations, concerning whether the parties wish to maintain the relationship alongside such conditions". (One of the university respondents)

Corporate partners presented the role of third parties in a significantly simpler manner: the influencers provided a source, or could play the parties participating in the co-operation against each other. In concurrence with the aforementioned, responding experts identified both supporting and obstructing roles. Supporting roles appeared, if *"…third parties mediate, provide references, and the co-operation in many cases is not even established without them"*, while obstructing roles primarily shifted the interest of the parties from the jointly defined objective. Experiences were diverse concerning the strength of influence or dependency, which fundamentally had to be evaluated as case-specific. Research institute participants regarded the role of third parties as strong in the case of public funders, while in other cases, evaluated it as case-specific. Companies, as opposed to research institutes, were divided in the issue, partly regarded the role of third parties as insignificant, while some saw a decisive role designated to third parties concerning the result of the co-operation. Responding experts regarded the role of third parties manageable, that is, not having a decisive impact on co-operation. Based upon the aforementioned, it can be summarized that no strong dependence on third parties can be clearly assumed or discarded based upon this analysis.

3.3. The conclusion of qualitative findings

Table 1 provides a final summary of the findings of the qualitative analysis. During the course of preparing a model as the objective of the analysis, as an initial step, the features describing results were summarized and separated with the processes and abilities on the side of both the service provider and the user. That was followed by grouping factors describing similar phenomena within the main dimensions separately in the case of both the service provider and the user, based upon the conducted interviews.

The model was defined as reflecting the viewpoint of both the service provider and the user (considering from a common viewpoint) as a set of factors, mapping by dimension phenomena that had been written off in the case of both supplier and buyer. In order to filter out possible contradictions, or at least questionable results, a comparative analysis was realised between the result achieved that way and the results of the theoretical model relying only on the results of concerning literature.

As a result of the analysis, the success of the co-operation can be described by two factors:

- the economic productivity of the co-operation: economic productivity, due to a higher level of predictability of the projects of the relationship, includes a balance in the cash flow, a higher cost-efficiency of projects, and due to the informality of interactions, a decrease of relationship building and maintenance costs, and parallel to the increase of confidence, an increase in the volume of orders.
- the technical/technological productivity of the co-operation: the technical/technological productivity includes financially less tangible factors that nonetheless provide a good description of the economic results of the co-operation, such as the achievement of objectives, the quality of the provided/used services, and the creation of extra results not agreed upon preliminarily (or at least not denominated) during the project.

Table 1. The model of relationship performance concerning vertical R&D co-operation: the view of results

The field of relationship performance	The dimensions of performance			
	From the aspect of the SUPPLIER	From the aspect of the BUYER	From a COMMON aspect	The impact of the NETWORK
Results	Continuity of revenues		Predictability of revenues/expenditures	
	Predictability of revenues			
	Size of revenues per project	Expenditure demand of solving emerging problems	Cost-efficiency of projects realised in the co-operation	
	Decreasing partner seeking costs	Reputation costs within the company emerging during proving necessity	Decrease of relationship establishment costs	
	Cost of labour time used in order to establish relationship	Cost of labour time		
	Travel costs	Travel costs		
	Accommodation costs	Legal costs		
	Conference costs			
	Representational costs	Representational costs		
	Communication costs	Communication costs		
	Number of projects included in the co-operation	Number of projects included in the co-operation	Number of projects included in the co-operation	
	Service quality	Quality of service	Quality of service	
	Emergence of further development opportunities	Emergence of further development opportunities	Creation of intangible property of other utilisation	
	(publishable) Scientific novelty			
	Creation of patents			
	Achieving common objectives	Achieving common objectives	Achieving common objectives	
	Sources that can be used more freely	Revenues from the sales of other products		Strengthening PR
	Increasing the quality of education	Recruitment and selection costs		Reputation

Source: own construction

Table 2. The model of relationship performance concerning vertical R&D co-operation: the views of Processes and Capabilities

The field of relationship performance	**The dimensions of performance**			
	From the aspect of the SUPPLIER	From the aspect of the BUYER	From a COMMON aspect	The impact of the NETWORK
Processes	Good communication	Speed of information sharing	Success of communication	Acquiring market information
	Predictability of capacities mobilised for the sake of projects realised in the co-operation	Control costs	Success of planning and implementation	Providing access to acknowledgement
				Providing vouchers for rights
	Clearness of problems to be solved	A behaviour increasingly adapting to the partner organisation		Profiting from each other's relationship system
	Accuracy of planning			Recommendations
	Predictability of management and organisational problems			Access to other sources (state)
	Professional consensus			
	Good task division	Development of control, organising costs	Success of co-ordination	
	Flexibility	Flexibility	Flexibility	
		Running time (development time)	Running time (development time)	
Capabilities	Partner-oriented way of thinking	Willingness to co-operate	Willingness to co-operate	
	Getting to know each other's demands and competences	Getting to know each other's demands and competences	Getting to know each other's demands and competences	
	Learning	Common individual and group level learning	Learning	
		Risk tolerating ability	Risk tolerating ability	

Source: own construction

The adequacy of the processes of the co-operation can be described by four factors according to the analyses:

- The adequacy of the communication applied during the co-operation, which means the adequacy of the information-flow among parties (the information reaches who and when necessary) and the speed of the information-flow.
- The adequacy of the management of co-operation, due to which the harmony of planning and implementation, and the coordination of co-operation improve during the co-operation.
- The flexibility of the co-operation, which describes the extent to which the parties can adapt their processes to each other.
- Development time realised during the co-operation, which describes the speed of the preliminarily defined R&D programs, compared to the experiences and demands of the partners.

Further developing capabilities created as a result of the co-operation are described by a further three factors:

- competence of co-operation, which describes co-operation willingness and the knowledge of the partner's organisation
- learning, which means acquiring professional and other skills during the co-operation with whose utilisation the partners are capable of increasing their own and their organisation's performance;
- Risk tolerating ability, which describes a higher level of confidence laid in the partner organisation.
- The applied factors and their definitions are summarized in Table 3.

Table 3. The summarised factors and their definitions: the view of results

Aspect	Applied factor	Factors describing factor	Definition of factor
Results	Economic productiveness of co-operation	Balance of cash-flow	a higher level of predictability of the schedule of revenues/expenditures
		Cost-efficiency of projects	cost-efficiency that the service provider senses in the decrease of the user's price sensitivity, while the user experiences it through the decrease of the expenditure required to solve occurring problems (which include the price and extra costs)
		Costs of constructing/ maintaining relationship	they manifest in the disappearance of partner seeking costs per project, the communicational cost savings of relations decreasing in frequency and/or becoming informal and the legal construction development cost-savings to be invested in order to deliver a given project
		Volume	it describes the increasing volume of commissions as a result co-operation
	Technical/techno-logical productiveness of co-operation	Achieving common objectives	it describes the attachment of projects realised within the framework of co-operation to preliminarily agreed objectives as success
		Quality of service	it includes service results adapting to the demands of the parties
		Creation of intangible property of other utilisation	it means the creation of further development opportunities, patents, publications, or their basic idea that can be freely used by the partners

Source: own construction

Finally, the impact of the network can be described along the following factors, based upon the interview analysis:

- Strengthening PR, that is, the increase of the acknowledgement and value of the various partners towards third parties, due to the co-operation;
- Reputation, as the reference value of the co-operation for third parties;
- Acquiring market information, that is, the informational profit of the co-operation, which manifests in information conveyed on third parties through the partner or the partner's behaviour;
- Profiting from each other's relationship system, which manifests in a certain support function through access to each other's acknowledgement, providing tools, databases, authorisations, etc, and through the advantages of recommendations towards third parties;
- Access to other sources, which primarily means better access to public funding or their utilisation.

Table 4. The summarised factors and their definitions: the views of Processes and Capabilities

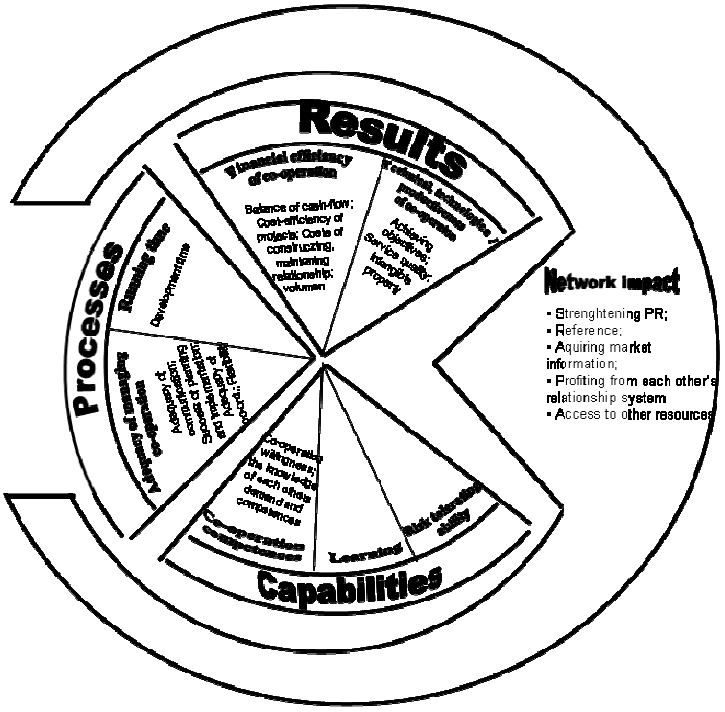
Aspect	Applied factor	Factors describing	Definition of factor
Processes	Adequacy of communication	Adequacy of communication	it means the adequacy of the information-flow between partners (information reach who and when necessary) and the speed of the information-flow
	Adequacy of managing co-operation	Success of planning and implementation	it describes a clear definition of problems, the accuracy of planning, increasing the predictability of emerging problems, the utilisation of capacities provided for realising the plan and simplified control mechanisms
		Adequacy of managing co-operation	it describes the improvement of task sharing and the improvement of the efficiency of control and organisation
	Flexibility of co-operation	Flexibility of co-operation	it describes to what extent parties are capable of adapting their operational processes
	Running time	development time	it describes the implementation time of preliminarily agreed development
Capabilities	Co-operation competence	Co-operation willingness	to what extent the partner can and is willing to think like the other partner and make proposals on solutions fitting for them
		Knowledge of each other's demands and competences	it shows the increase in the level of knowledge of the partner organisation with the passing of time
	Learning	Learning	it means acquiring professional and other skills during co-operation with whose utilisation the partners are capable of increasing their own and their organisation's performance
	Risk tolerating ability	Risk tolerating ability	it describes a higher level of confidence laid in the partner organisation

Source: own construction

4. Summary

To summarize the above mentioned results, the performance of the university-industrial co-operations can be described with the results from the consequences of ex post activities, with the process resulted from the existing co-operation and with the capabilities which provide the opportunity to co-operate in the future. Based on the researches and qualitative analysis, it can be established that co-operation has an intermediate role too, called network impact. The general model of the relationship performance is presented in Figure 1.

Figure 1. The model of the performance of university-industrial vertical co-operations



Source: own construction

The model suggests and discusses some "opened" questions: the relation between the several aspects of relationship performance; the relation between relationship success and relationship performance and the relation between network effect and relationship performance. To answer these questions requires a quantitative analysis with a larger sample. The exploration of the factors doesn't mean the solution of the problem, but it helps to get near to the two-sided utility maximization of the management of university-industrial co-operations.

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